UNITED STATES GOVERNMENT Forest Service
Washington, D. C., 20250

M E M O R A N D U M Date: May 1, 1964

To : R. M. DeNio, Director, Division of Range Management

From : John S. Forsman, Chairman, Range Seeding Equipment Committee

Subject: Improvements

There follows a report on the activities of the Range Seeding Equipment Committee during 1963. A copy of each written report submitted by the subcommittees at Wichita, Kansas, on February 9-10, 1964, is attached to the original of this report.

The 1964 range seeding equipment project assignments which were developed by the Committee at Wichita are also included. The development work to be undertaken at the Arcadia Equipment Development and Testing Center has been reviewed and approved by the Forest Service Technical Equipment Board, subject to the receipt of funds from the three agencies that are participating financially.

The material is arranged in the following order:

John S Foreman

REPORT OF THE EIGHTEENTH ANNUAL MEETING OF THE RANGE SEEDING EQUIPMENT COMMITTEE

Wichita, Kansas
February 9-10, 1964

The 18th annual meeting of the Range Seeding Equipment Committee was called to order by General Chairman Frank J. Smith, at 9:15 A.M., February 9, 1964, at the Broadview Hotel, Wichita, Kansas. The registered attendance totalled 76 persons, representing Federal and State agencies, colleges, and others from all parts of the United States, interested in equipment development.

The proposed program, which was submitted to all interested persons prior to the meeting, was followed with few exceptions in the order as presented. The following are summary reports of papers presented at the meeting. A complete copy of the full report submitted is attached to the original of this report.

Report on Pipe-Laying Machinery, Recommendations for Modification.

By Warren Miller, Acting Subcommittee Chairman.

Last year's report, submitted by the Subcommittee, was complete with pictures, statistical cost and design data. Essentially, last year's report is resubmitted as no new developments or improvements are known to have occurred. This applies to four machines which were reported last year.

No commercially produced machine is available. Those reported were innovations by individuals or agencies mounting the reel and shoe or feeder tube on road graders, tractor dozers, and the Wyatt Manufacturing Company's Jayhawk Model 800 tool carrier.

All adaptations appear to have the same deficiencies, i.e., poor reel design and inadequate feeder tube or shoe, not allowing free movement of pipe through the tube. Presently used reels cannot accommodate the various size pipe, 1" to 2", nor the various size coils of pipe.

Producers of cable laying machines have suggested adapting their equipment to laying plastic pipe. Two primary objections to this idea are excessive weight and cost.

The Equipment Development and Testing Center, Arcadia, has made preliminary investigations into the development of a plastic pipe laying machine. No fabrication has been initiated. The machine proposed by the Equipment Development and Testing Center would incorporate a shoe design capable of laying up to 1½-inch plastic pipe to a depth of 20 to 24 inches as well as adjustable reel, with hydraulic lift, capable of handling various size coils. The estimated selling price is between $1000-$1500.

Report on Improvements for Fence Building Equipment.

By Orval Winkler, Subcommittee Chairman.

Past accomplishments are reported in the 1963 report.

Fence-building machines were used in 1963 construction jobs in Central Nevada and in Eastern Oregon by the Forest Service. The machine tested was the Fury Fencer.

Oregon Report.

Fifteen miles of fence were constructed. Terrain varied from easy to extremely difficult with heavy rock conditions. Specifications were three strands of barbed wire on steel posts spaced 25 feet apart. It was concluded from this test that a 3-man crew is usually most efficient. To hold a line, a sighting device was mounted on the front of the tractor. A wheel tractor unit was used and it was recommended that a crawler type would be a better unit.

It is believed that the woven wire equipment on the dispenser is unnecessary and recommended that a machine be produced without this equipment. Only well-qualified, trained crews should be used with this fencer. Nicropress sleeves expedite splicing.

Several modifications for betterment of the machine were proposed and are listed in the complete report which is attached to the original of this report. Average cost for construction with the Fury Fencer was $607.15 a mile, for a total of 10½ miles. This compared to the conventional method of construction on a contract at $728 a mile.

Conclusions from the 1963 Oregon trials include: (1) The fencing machine did a satisfactory job; (2) some design modifications are necessary; (3) the weld joints on the machine were not strong enough to withstand the stress placed on the equipment when it was used over rugged terrain; (4) once trained a crew will do an efficient job and build fence at less cost than going contract prices; (5) a suitable crawler-tractor equipped with a dozer blade and a properly designed 3-point hitch is recommended as a power unit.

Nevada Report.

A Fury Fencer was attached to a D-4 caterpillar crawler-tractor with an improvised 3-point hitch. This power unit was satisfactory. The improvised 3-point hitch was unsatisfactory.

Conclusions from the Nevada test include: (1) The fencer did not operate satisfactorily where contour slope exceeded 20 percent and direct slope 40 percent, nor on rocky terrain; (2) the hitches and hydraulic system on the power unit must meet the mechanical requirements of the fencer; (3) as was found in 1962, there was difficulty in setting corner and brace posts. The machine is very efficient on long, straight sections of fence which are located on easy terrain.

The Subcommittee recommends: (1) Engineer 3-point hitches for crawler-tractors to be used as power units with the fencing machine; (2) adapt the hydraulic system on the tractors to balance with the system on the fencer; (3) have the manufacturer's representative train the machine operator; (4) strengthen known weak points on the fencer unit to withstand the stresses encountered in wildland fencing jobs. Request the assistance of the manufacturer's representative to get this job done; (5) continue the performance testing in 1964; and (6) build all steel fences on the sites selected for 1964 tests.

It was stressed during the general discussions that rock and soil conditions determine to a large extent the efficiency of the machine. In the Nevada test, holes had to be pre-punched before setting steel posts. It was concluded that the machine is practical and its use should be continued. The group agreed that the woven wire factor should be eliminated. The machine costs from $3100 to $3400.

Report on Root Plows and Recommended Improvements.

Report prepared by C. S. Fonte, Subcommittee Chairman, and presented by M. F. Brandborg.

Plans for the year included an evaluation of (1) the use of the packer for loose soil, (2) special blades designed to leave furrows in which to seed, (3) present equipment and past work done with root plow equipment, and (4) prepare the root plow section for the Equipment Handbook.

The packer was used by the Bureau of Land Management in New Mexico. It was effective on sandy soil. It smoothed as well as packed the soil and reduced wind erosion. The machine packed heavy clay-type soil too tightly for satisfactory water infiltration and is therefore not recommended for use on this soil.

The project where the special blades designed to leave furrows was to be tested did not materialize.

Most of the plowing and seeding has been successful. Meaquite areas in Texas, Oklahoma, New Mexico and Arizona show root plowing and seeding have increased forage production up to ten times. It is considered an established successful practice for the landowners of this area. The standard Fleco root plow with depth adjustment and shaker bars is the accepted equipment. Average cost is $12 to $15 per acre plus cost of seed. Contractors with equipment are generally available. In the Intermountain area of Gambel oak, greasewood and sagebrush areas, root plowing and seeding have been successful in killing brush and in most cases increasing grass production; however, due to the high cost of $15 to $20 per acre, the practice has not been accepted by the ranchers. The main reason for non-acceptance is the brush can be aerial-sprayed with herbicides for an average cost of $3.50 per acre with good results. A summary of the 5-year observation plots of root-plowing done by McCoy Caterpillar Co. and the Soil Conservation Service in Colorado shows a kill of 65 percent to 100 percent five years after plowing. All the plots show a dominance of grass wherever there was a dominance of brush before plowing.

The Subcommittee prepared the root plow section for the Equipment Handbook.

Although the Subcommittee suggested that they be dismissed as there is no more to be done on their present assignment, the Committee favored continuation. Much root plowing has been done and is continuing. Further evaluations are needed.

Operating Hints and Service Manual Handbook Report.

By A. C. Hull, Subcommittee Chairman.

This committee is responsible for revising and publishing the following handbooks and manuals:

(1) Operating Hints - This publication includes field use, and servicing and storage of machinery. Four thousand copies were printed and distributed in 1961. Cost was 5-6/10 cents per copy.

(2) Service Manual with Parts List - These manuals include maintenance and servicing, mainly in shops. Commercial manuals will be used where available. Manuals will be prepared for newly developed equipment.

(a) Brushland Plow Manual - 200 copies were printed and issued through Arcadia in 1961. If there is a demand for revising and reprinting this manual, it can be done.

(b) Rangeland Drill Manual - This manual was partially completed at Arcadia during 1962 and 1963. It is hoped that it will be available during 1964. The Subcommittee needs estimates of agency needs before printing.

(3) Range Seeding Handbook - This handbook includes types of equipment with recommendations as to their use. It was revised in January 1957, and 2020 copies were distributed to agencies. The entire handbook is now in the process of revision. It is planned to print and distribute it during 1964.

Printing. Printing will be handled as a Forest Service Category 2 Handbook. The Committee will furnish the Forest Service all plates, drawings and material needed for printing. The Forest Service will print the number of copies ordered by each agency. Agencies will handle their own distribution.

As new handbooks are written and present handbooks or manuals need partial or complete revision, we will convert to the above system. Therefore, all plates which might be used for reprinting should be sent to the Committee Chairman, Forest Service, Washington, D. C., 20250.

Equipment Parts Distribution Report.

By Everett Doman, Subcommittee Chairman.

Central parts stock facilities for the Rangeland Drill and Brushland Plow at the U. S. Forest Service Equipment Depot, Stockton, California, have been in operation during the past four years. Parts stock for the Rangeland Drill was established in 1960, and for the Brushland Plow in 1961.

A review of orders for the Rangeland Drill and Brushland Plow parts for calendar years 1961 to 1963 shows a constant increase in utilization of the facilities at the Stockton Depot.

	CY 1961	CY 1962	CY 1963	Expansion Factor (%)
Rangeland Drill parts	14	17	31	Increased 82% over CY 1962
Brushland Plow parts	4	9	12	Increased 33% over 1962
Totals	18	26	43	Increased 65% over 1962

Improvements have been made in developing complete and accurate lists with the addresses of Rangeland equipment. The list is attached to the original of this report. The Committee asks that Stockton Depot be informed of any users of Rangeland equipment not shown on the list. Further development of complete inventories, locations, year models and condition of equipment should be accomplished. This information is helpful in providing a basis for maintaining stock levels of parts. This will become more and more important due to modifications and design changes of new machines. There no doubt will come a time when orders for parts will need to include year models for the machines for which parts are being ordered.

There are instances where users are seemingly not aware of the replacement parts facilities at the Stockton Depot. Some orders for parts are still being sent to the Arcadia Equipment Development and Testing Center, which in turn forwards them to the Stockton Depot. This causes some delay in receipt of parts at destination. There are also occasional delays in the manufacture and supply to the Depot of parts procured through bid contract procedures. However, to improve parts stocking and service to the users, the Stockton Depot is manufacturing parts to a considerable extent and open market purchases from established sources are being exercised where possible.

The Committee recommended the following for C.Y. 1964:

1. Project to be completed to provide a service manual for the Rangeland Drill. Three hundred copies to be printed and the manual to be stocked at the Stockton Depot after initial distribution by the Committee or by Stockton if desired.

2. One hundred more service manuals and parts lists for the Brushland Plow to be printed and stocked at Stockton Depot. Manual to be brought up to date by Equipment Development and Testing Center.

3. Units not having already done so furnish the U. S. Forest Service Stockton Equipment Depot, P. O. Box 70, Stockton, California, information concerning the machines on hand.

4. Parts list to be revised annually by Stockton Depot, and distributed directly to parts customers. This has been accomplished for 1964.

The Committee discussed the importance of everyone using the Stockton Depot facility. Our field offices should have information readily available regarding what shall be ordered from Stockton and how to place the orders. It will be helpful if good communications are maintained between those who attend this meeting and our field people. The Subcommittee wishes to know of any difficulties the field experiences in placing and receiving orders.

Report on Tests and Investigations of Browse Seed Collector.

By William P. Dasmann, Subcommittee Chairman.

A three-man jeep, scout or pickup mounted vacuum seed harvester was designed and constructed at the Development Center. Development of a one-man portable rig has been deferred until the mobile collector is field-tested. Tests were made on several browse species during 1963 with the following results:

Fourwing Saltbush. The machine worked very well and gave no mechanical trouble. The use of a funnel 18 inches in diameter improved performance. A 2-inch mesh screen inserted over the end eliminated larger trash. A total of 405 pounds of cleaned seed was collected in New Mexico at a cost of 57¢ per pound. As a result of this trial, the Southwestern Region of the Forest Service ordered a harvester for use by that Region.

Trials on fourwing saltbush were made in Utah in December after the utricles had fully dried. The machine harvested clean seed at a rate of 16.98 pounds per man hour as compared to 28.30 pounds per man hour for the hand technique. There was no difference in the impurities between hand and machine collection. Bushes were heavily laden with seed. Even though the harvester was slower than hand collecting it did exhibit an ability to pick up seed from under the bushes more rapidly and better than could be done by hand.

Bitterbrush. This was an unusually heavy bitterbrush seed production year. Three to six-inch hoses were tested. The yield was much greater with the 6-inch diameter. A comparison was made of complete stripping of seed from each bush with high-grading. The advantage of high grading seemed to be offset by the time lost in moving from bush to bush.

Some seed was collected by hand. A comparison showed that 83 percent of the machine-collected material was waste, whereas 44 percent of waste occurred in hand collection. Also, over an 8-hour period more seed was collected per man by hand at less cost per hundredweight than by machine. There was no advantage to machine collection when used on this species.

Lemmons and Wedgeleaf Ceanothus. It was difficult to pull seed-pods free from plants with vacuum hoses. A piece of 6-inch galvanized stovepipe was attached to each hose in an effort to solve this problem. By slipping the pipe over branches and applying a raking motion some seed was obtained. However, results were poor and there was a large amount of trash. If the raker-cutter were attached to the end of the collector hose the machine's effectiveness might be improved. A trash cleaner attachment would reduce total costs but since cleaning costs ($4.66 per pound) were only a fraction of the total cost for the cleaned ceanothus seed, the gain would still not make the machine competitive with hand collection for this species.

Mountain Brome and Other Herbs. Clean seed from mountain brome was harvested at a rate of 2.06 pounds per man hour by the machine and 3.34 pounds per man hour by hand, or close to a 3 to 2 ratio in favor of hand collection.

It was estimated that hand harvesting was from 1/4 to 1/2 faster on all species except aspen fleabane, mountain dandelion and spreading aster. The vacuum machine harvested seed of these three composites slightly faster than by hand and with much less pain.

Additional short trials were made on other shrubs and in only the instance of western virginsbower did the vacuum machine out-produce hand harvesting.

It appeared evident that the Arcadia vacuum seed-collector in its present state of development is slower than hand collection for most species, and that seed costs are greater with the machine. It seems probable that further development of the machine will increase its efficiency. There was no agreement as to whether the machine can be made as efficient as hand collection for most species. It is recommended that the vacuum seed-collector be further refined and that future tests evaluate costs under one-hose operation as compared to two.

The development of a one-man back-pack type machine will probably not be possible because of the weight of the machine and other material which must be carried. A mule-pack type machine was suggested.

Report on Performance Tests and Recommendations for Improvements of Hansen Browse Planter.

By Perry Plummer, Subcommittee Chairman.

The planter is made by the Hansen Machine Co., Ephraim, Utah. The builder continues to improve the machine. All weak points have been strengthened. Cost is $570.00, equipped with two 6-inch moldboard furrow openers and two seeding units. The 20-inch and 30-inch wide scalpers for eliminating herbaceous competition are available for $65.00 each. Seeding units cost $200.00 when purchased separately.

Twelve browse seeders are now in the field. Performance reports have been highly favorable, except in one instance where one of the machines was pulled by a D-4 caterpillar with a rigid hitch in very rocky and frozen ground. To stand D-4 caterpillar drawing power in rocky and frozen ground, it was found

that a 3-point hitch must be used or it was necessary to weld the hitch to the drawbar. Heavier depth gauge shoes were provided on this planter.

The machine can perform a multitude of planting assignments. It can be quickly adapted for pulling behind other furrowing machines or scarifying equipment over a wide range of site conditions.

A redesigned clamp assembly holds the furrow opener and seeder by one clamp. It is stronger and simpler and makes the machine a little more maneuverable.

The drawbar has been increased in strength by welding a 4-inch wide and 1/2 thick channel steel plate to the pipe drawbar. This makes it possible to keep the attachments in place. Wheels, rather than shoes on the depth gauges, can be provided if desired. The committee has not had an opportunity to test the wheels to determine their advantage over the shoes, but plans to do this in the near future.

Some jamming of the seed agitators has occurred when backing up without lifting the machine out of the ground. This weakness has been corrected on new machines. The builder points out that this machine can be increased in strength to match the draw power of heavier crawler tractors. If a heavier machine is wanted no doubt arrangements can be made with the Hansen Machine Co. at Ephraim, Utah, to build it.

Rooter Points. Tests made on the Kaibab Forest showed that rooter points faced with carbide outlasted by several times regular rooter teeth. Carbide-faced points on rooter teeth are recommended especially for volcanic and granitic soils, where the grinding action by the soil and rocks on the points is severe.

The Caterpillar Company makes a point that can be substituted for the one made by the Hansen Machine Company. Since these points are available from caterpillar dealers it is planned to use them as standard equipment in the future for the 6-inch moldboard furrow openers. Truck axles will be used for the rooter points for the 20- and 30-inch scalpers.

Report on Performance, Accomplishment Tests and Evaluation in Hard Brush of both Front End and Towed Brush-Cutter.

By George Nordstrom, Subcommittee Chairman.

Due to increasing needs and interest in brush control, a method is needed to eliminate mature brush without adversely affecting the soil to facilitate subsequent treatment application. Available commercial equipment is generally inadequate under prevailing conditions. Two cutter units have been designed by AEDC since 1957. One unit is a D-7 size front-mounted type, the other a trailing or towed type. The following changes and/or improvements were made in 1963:

A chain skirt was installed to reduce the hazard of flying sticks and debris on the towed unit. The front-mounted unit was converted to operate

on a hydraulic control instead of the original cable control tractor. Other improvements made on both units include: placing more suitable locking nuts on the cutter blade bolts, locating cutter motor starting control on the tractor for operation convenience, and placing cutters over cutter drive shafts.

The front-mounted unit was tested in the Sacramento area. The stand varied from dense to open and was composed mainly of the following brush species: sumac, scrub oak, chamise, manzanita and ceanothus. Granite rock outcrops were frequent and hard to detect, owing to a serious dust problem. The unit was operated in first gear. Also, it was necessary to halt forward progress in large clumps of sumac to avoid stalling the cutter motor. Other than this, the unit's accomplishment was very satisfactory. The wheels were used and found to be essential in the opinion of the highly experienced operator. Total cost per acre was $12.72.

Some of the problems on this project included the following:

1. Straightening and "beefing-up" cutter arms.
2. Keeping cutter bolt nuts tight - finally welded.
3. Keeping cutter wheels in operating condition.
4. Replacing bolts in cutter drive shaft housing.
5. Keeping tractor radiator free of leaves and debris.
6. Welding-up main coupling between tractor and cutter.
7. Normal shear-pin replacement.

The operator on this unit is of the opinion that the wheels are important if used with hydraulic controls, so that the tractor hydraulic unit may be operated in "float" position. Otherwise, the connection between the tractor and cutter is too rigid. There is some question whether this unit should have been converted to the hydraulic controls.

The towed unit was tested on the McCloud District, Shasta-Trinity N. F. in a dense stand of brush composed predominantly of greenleaf manzanita and insignificant amounts of wedgeleaf ceanothus and antelope bitterbrush. A D-7 was used because of its availability. The tractor was operated in first gear.

The unit's accomplishment was very satisfactory when in operation. Brush on 30 acres was cut in 29 hours actual operating time with additional 26 hours of breakdown time. Total cost per acre was $33.

The main difficulty experienced was shear pins. New coupler plates were fabricated to accommodate 4 shear pins, rather than 2.

A continuous run of sufficient duration was not experienced to obtain reliable performance or cost data. Forest personnel were pleased with the quality of work performed by the cutter. As in past tests, breakdowns continue to be the serious problem. Perhaps there is a general tendency toward forcing the cutter beyond its capabilities. It may be necessary to "beef up" the machine or limit its use to brush stands with a predominance of stems 3" or less in diameter.

Recommendations.

1. "Beef up" both units or construct a more rugged unit if larger shrubs are to be cut.

2. Develop a signaling device so that the operator will know when the cutter motor stalls.

3. Improve locking nuts on the cutter blade bolts.

4. Consider a more rugged wheel assembly for the front-mounted unit.

5. Add a cover or other protection for the hydraulic hoses on the front-mounted cover to protect them from rubbing by standing brush.

6. Replace coarse-threaded bolts in cutter shaft housing with fine-threaded bolts and add lock washers.

7. "Beef up" the cutter arms on the towed unit.

8. Devise better supports for the exhaust and intake systems of the cutter motors.

9. Install a reverse or blower fan on the tractor carrying the front-mounted unit.

10. Replace 6" pipe in frame of front-mounted unit or weld in better support braces, if and when present field repair fails.

Comments from Group.

Building new tow type may be impractical - no definite recommendations. Be more selective in sites to prevent tremendous breakdown. Front mounted unit seems to be best but doubt if machine could be beefed up to compete with the proposed brush cutter and chipper equipment.

Silva recommended heavier equipment. He thought we could do better with present machines, but will take heavier outfit for manzanita, etc. He recommended those interested in this type of equipment see the "Tree Eater" exhibit.

Report on Investigation and Introduction of Proposed Brush Cutter and Chipper Equipment.

By A. B. Evanko, Subcommittee Chairman, and Eugene E. Silva.

The investigation revealed a machine called the Tree Eater. This machine was developed for use in orchards as a hogger to chew up and thus dispose of windrowed pruning material. This development started in about 1936. The machine as developed today is used for clearing pipeline and power lines. There have been seven machines built. The machine which was investigated was mounted on a OC9 cat, which is somewhat smaller than a D4.

The equipment is saddle mounted and has a separate engine on the back - 280 HP. This machine has a front-end drum with 70 hammers or cutters which rotate at 1800 RPM. It shreds brush material into a fine residue which resembles excelsior.

This machine was used on the King Ranch in Texas and cleared two acres of brush per hour. The machine costs $39,000 and is constructed by the Tree Eater Corporation.

An advantage of the machine would be its versatility in that it could be used in timber, fire and other multiple uses.

A film was shown of the machine in operation clearing power line rights-of-way. This machine uses a shredding action which is an advantage over the chipping action of most machines.

Aerial Application.

By Morley F. Brandborg, Subcommittee Chairman.

Acreage Measurement

The use of aerial photos is the preferred method of area determination. It offers the best compromise of acceptable accuracy at reasonable cost. Area determination usually is done twice:

a. Before treatment to prepare accurate prospectus for bidding.

b. After treatment as a basis for payment. Most contractors will accept the aerial photo method of area determination.

Two requirements must be met to make the process acceptable. First, control must be good enough that photo scale can be accurately determined. Second, the delineation of area must be a field job, both pre- and post-treatment.

The only other method of area determination is the actual ground survey. This much more expensive method is used in cases where absolute accuracy is required.

Actual or slope acreage in rough, steep terrain may be considerably greater than map or horizontally measured area. This can affect bid prices. Bid forms and contracts should specify the method of measurement.

A few BLM contracts were let on the basis of gallons of herbicide mix applied rather than on acreage. There appeared to be enough advantages to this system that additional trials will be run next spring by the Bureau of Land Management.

Bi-Fluid System with Invert Emulsion

The Bi-fluid system and invert emulsions are becoming important as planned spray areas become smaller and the need for protection of vegetation becomes

greater. The committee reported on one trial which involved a small project on the Rio Grande N. F. covering 8 areas of about 12 acres each in size. Each area was treated differently. One and two pounds per acre, each in 8 and 16 gallons of mix per acre, of oil soluble amine and of low volatile ester of 2.4-D were used on rabbitbrush. The formal report of kill will not be available until next year. Preliminary indications are that the kill may not be satisfactory. While soil moisture conditions at the time of spraying were good, there was a prolonged dry spell immediately following spraying.

One item for attention may be that proper formation of invert emulsions depends on water temperature. For best results the temperature at the nozzle should be about 70° F. This may present a problem at high altitudes and in early morning.

Costs

Committee members collected costs on projects covering well over 250,000 acres of fixed wing and over 55,000 acres of helicopter jobs. Of the projects submitted, 28 were similar in that they all involved the application of two pounds of 2,4-D in 3 gallons of diesel per acre. Fifteen of these projects involved fixed wing application, and 13 involved helicopter application. These were used to compute averages. Costs averaged $2.70 per acre for fixed wing, and $3.71 per acre for rotary-wing work.

The table below will provide figures for a rough approximation of probable costs of projects for planning purposes.

Average Costs

Herbicide	$1.08 (2#/a.)
Carrier	.40 (3 gal./a.)
Mileage and per diem	.08
Overhead	.12
Flagging	.14
All other	.06
Application 3/fixed wing	.82
Application 3/helicopter	1.83

Increases or decreases will result from using different herbicides, carriers, rates of application, administrative costs, bidders' base-to-job distances and other factors.

In general we can say that helicopter jobs will cost nearly 40% more overall than will those done with fixed-wing aircraft. Helicopter application costs alone still are slightly more than double fixed-wing application costs. In two reported instances, however, rotary-wing costs were below the average cost of fixed-wing jobs.

Generally, jobs done with small aircraft are cheaper. Maintenance is great on larger aircraft and this is a major factor.

The helicopter people have developed equipment which can now spray a 150-ft. strip. This will make their machines better able to compete with fixed-wing aircraft.

The committee feels that there is no more to do in determining area measurements and that there is little to be gained from continuing the study of costs each year. They have prepared a draft of the proposed aerial application section of the Range Seeding Equipment Handbook. The Subcommittee reported that they would be happy to undertake any assignments given them but the present assignments were completed.

Report on Modifications and Performance of Ground Spraying Equipment.

By A. B. Evanko, Subcommittee Chairman.

Region 5, Forest Service, purchased three spray units (two for TD-340 and one for JD-1010 tractors). The final cost was $1697 and $1766 for the TD-340 and JD-1010 units, respectively.

Performance of the unit varied from poor to excellent dependent upon project area conditions and to a degree on user or operator attitude.

a. Poor accomplishment with the TD-340 unit occurred on a scrub oak (Quercus dumosa) area. Oak had been removed with a brush rake and piled. Numerous burls, incompletely uprooted, remained scattered over the area. The area ranged from level to 30%, and averaged about 18 percent slope. Numerous breakdowns and stoppage precluded obtaining reliable accomplishment and cost data.

   The greatest problem encountered under conditions of the project area was associated with tractor characteristics, namely narrow gauge and short tracks. Difficulty was experienced negotiating slopes in excess of about 20%. Presence of burls and rocks in the path of the uphill track and depressions in line of the lower track rapidly and materially changed the operating angle. Up-slope operation was much the same when rocks or burls were encountered - weight of spray material shifted to the rear causing the tractor to literally stand on end. Operators eventually became reluctant to work slopes in excess of 15% thus reducing overall efficiency. A continuing nuisance problem is associated with the boom. Bending the boom, loosening and breaking of U-clamps and bolts, etc., result in a material loss of operating time.

b. Quite satisfactory performance was obtained with TD-340 and JD-1010 units on other locations in the California Region. The TD-340 units were used on chaparral conversion projects and the JD-1010 on a big sagebrush project. Topography and

surface obstacles presented little problem - maximum slope gradient approximated 20%. Personnel using the equipment were well pleased with the machine's performance.

The operating rate of these units was equal to or better than that obtained with larger units (D-7 mounted) and at a lesser cost. Accomplishment varied by area from 6 to 9 acres/operating hour.

Rollagon Unit

The Rollagon unit was shipped from Montana to Southern California for use in fire studies. At the close of fire season, Arcadia planned to adopt a boom to the unit. Overruns in higher priority projects resulted in a shortage of funds. It was therefore necessary to defer action until further direction is obtained from the committee.

Recommendations

Small Tractor Unit

After three years of testing a divergence of opinion prevails regarding the small tractor's adequacy. Some users are satisfied while other recommend a wider gauge tractor in the D-4 or TD-9 class. The wide-gauge feature is perhaps one worthy of committee consideration but also poses a number of problems. The Rollagon unit merits serious consideration as a desirable alternative course.

The following recommendations are therefore concerned only with improvement of the spray unit proper based on rather extensive use this year.

1. Additional improvement of the retraction feature of outer boom sections. The present difficulty is the jarring impact upon return to normal position.

2. Provision is needed for a lower boom height adjustment, to an 18" level rather than the present 3'.

3. Desirable to have a pump capable of 50 g.p.m. minimum output to permit transfer of spray mixture between tanks when contour spraying.

4. Outlets at both ends of the tanks, equipped with quick action valves accessible to the operator, would eliminate problems encountered when operating up or down steep slopes. With the present outlet centered in the tank, only two-thirds of the tank's contents can be utilized under these conditions. A redesigned tank to form a reservoir or pocket at the outlet may be another possibility.

5. Arcadia to weight the merits of a modification to eliminate the need for removal of the blade and hydraulic equipment to enable mounting of the spray unit.

Rollagon Unit

It is recommended that funds be made available this fiscal year to proceed with the work as planned. This course is considered most timely inasmuch as the unit will not be available to the committee during the fire season. Multi-purpose development of the unit is a further consideration.

Comments

A very good film was shown of one of the small units. During the group discussion there was more favorable comment than otherwise of these small units. The danger from overturning the tractor on slopes is very remote and the bigger problem appears to be in a reluctance of some operators to use the tractor on slopes because of their unfamiliarity with these characteristics.

Report on Chemical Plant Control.

By Donald R. Cornelius, Subcommittee Chairman.

The Chemical Control Handbook published in 1959 is in the process of revision. This handbook will contain a list of plants which can be controlled. Mr. Cornelius emphasized that just because a plant was listed did not mean that the subcommittee or the Range Seeding Equipment Committee or anyone else was recommending that the plant be controlled or eradicated. The amount of control will remain with the land manager.

Assignments have been made to committee members who are assembling information on 94 different species of vegetation. These reports will be assembled, reviewed and submitted for clearance through the Washington office.

Interseeder - Report on Problem Analysis and Presentation of Recommendations for Further Action.

By Ralph Cole, Subcommittee Chairman.

The committee was to determine if existing equipment is adequate for interseeding in old crested wheatgrass stands, abandoned fields, cheatgrass, and other poor condition range. This report is limited to planting native climax range plants directly into whatever vegetation is now occupying the range site.

The interseeding practice is well established in the Great Plains where bluestems, switchgrass, Indiangrass, sideoats grama, western wheatgrass and green needlegrass are all being successfully established. Results are good. Green Stipa, for example, has produced almost twice as much vegetation as crested wheatgrass and other introduced grasses after the fifth year of the study.

It is impossible at this time to determine the acreage that should be interseeded. In many important range areas the practice has not been tested enough to know if it should be used. In the Great Plains section it is estimated that 10 million acres should be interseeded. In the other Western States the practice is too new to estimate its need.

The use of interseeding in many range areas still needs to be investigated. However, it is logical to conclude that grasses can be planted that once were most important on an area of rangeland. These grasses will probably do better on a site than any other species. The methods will need to vary with the soil, climate, kind of grasses, etc.

Equipment which has been used for interseeding includes:

a. The John Deere Grassland drill has been tested in many locations in South Dakota and found to be unsuccessful in most cases. This drill does not destroy present vegetation on the site and seedlings are lost through competition. A wide cultivator shoe can be mounted on this drill; however, it is more practical to design a lister or sweep type interseeder.

b. The Deep Furrow drill has been successfully used on the National Grassland in Oregon. It does not make a wide enough furrow in some types of range vegetation.

c. Double disc opener drills with depth bands such as the Nisbet or John Deere rangeland drill have been used in the plains to plant thousands of acres of cultivated land to native grass. They are successfully interseeders only in very wet years or in situations where there is little vegetative competition.

d. The lister type interseeder has been quite successful on many different soils and with different grasses. However, it has the following disadvantages:

   (1) Furrows are not wanted by some ranchers who wish to hay the areas.

   (2) On some soils the furrows silt full burying the seed too deep.

   (3) Severe crusting on heavy soils has prevented seed emergence. Crusting is more severe during certain times of the year, so that timing is important.

   (4) The competition from old crested wheatgrass plants is too severe with a 14" lister furrow. A wing protruding about 6 inches to the side of the lister is needed.

   (5) Scalping the top one or two inches of topsoil sometimes causes a fertility deficiency. This problem can be solved by fertilizing.

   (6) Seedling blight has been a problem on some projects.

   (7) This type seeder will not work well in rocky soil.

e. Sweep type interseeding is done by pulling a drill directly behind an 18" sweep with the sweeps set at 42" spacing. This machine has been used successfully. The main disadvantage is that annual seedlings may grow in the disturbed area.

f. A large disc type of furrow opener which made a furrow about 1 foot wide and 1"-2" deep was used successfully at Garden City, Kansas. This interseeder gives about the same results as the lister type. However, it will work better than the lister in sagebrush or rocky soil.

g. Range grasses were successfully seeded by helicopter on the Green Canyon burn near Hot Springs, South Dakota. This system may require fire or spraying to destroy competing vegetation to make the operation successful.

It is recommended that the Arcadia Equipment Development and Testing Center coordinate our efforts to develop an interseeder. Native range grasses start so much slower than introduced grasses that completely different seeding methods and equipment may be needed. Trials should be made of existing interseeding equipment. It is likely that Arcadia will need to develop a more sturdy piece of equipment to interseed on wild lands.

Tractor-Mounted Drill - Report on Tests Made and Presentation of Recommendations for Future Work.

By W. F. Currier, Subcommittee Chairman.

The objective of this project is to provide equipment which will clear brush and trash and drill seed in one operation.

Many thousands of acres needing improvement have trash and down material on the ground. Broadcasting grass seed in such areas has not been as satisfactory as where the seed has been drilled into the ground.

These conditions occur where:

1. Juniper has been previously cabled or pushed.

2. Juniper control and forage establishment are both needed.

3. Down timber due to blow-down, wild fire or other reasons is present.

The plan of action for the past year was to:

1. Plan a hook-up for the drill and select the proper size tractor.

2. Assemble the equipment and field test it.

This action has been completed. The present design requires a D-6 or larger tractor with a safety cab and cable type dozer, and a rear-mounted cable power control unit for lifting the drill. If a tractor of suitable size is available without a safety cab, it will be necessary to install an overhead structure to support the drill lift.

The equipment was tested at Bernalillo, New Mexico, January 20. A small rangeland drill was mounted behind a D-7 cat. A D-7 was used because the area needed juniper pushing and grass seeding which was done in one operation.

The limited test indicated that such an operation is practical. By controlling the drill through the lift mechanism, the desired maneuverability was obtained. No problems were encountered in backing the equipment. Once the operator became accustomed to the equipment, pushing juniper and seeding could be done almost as fast as pushing alone.

The test indicates that the tractor mounted drill will:

1. Allow clearing and drilling to be accomplished in one operation.

2. Enable drilling equipment to go anywhere a "cat" tractor can operate. This will open up a large area to a drilling operation, formerly impossible to drill.

3. Offer a good possibility for drilling tree and browse seed on areas where timber has been destroyed by fire.

The recommended plan of action for next year includes:

1. Improving the hook-up to eliminate swinging of the drill when it is in a suspended position.

2. Providing another pulley in the hook-up so that lowering and raising of the drill can be slowed down.

3. Field testing on a 500-acre project at Prescott, Arizona.

4. Completing the drawings and specifications for the hook-up.

Rangeland Drill, Brushland Plow - Report of Accomplishments on Plan of Work for Past Year.

By A. B. Evanko, Subcommittee Chairman, and Gene Silva.

The Brushland plow and Rangeland drill projects were reactivated this year to incorporate desirable additions and modifications based on field use of the equipment.

Brushland Plow - Project 328.

Work on the Brushland plow included replacement of the double axle trunion wheels with a single tail-wheel unit, and revision of the materials list and specifications to conform to this modification. Instructions were furnished to the field for modification of other plows. A knuckle joint steering arm extension was provided which offers greater leverage and aids in steering the plow. Such an arm, without the knuckle joint, was tested and was shown to improve the steering.

Making the change from a four-wheel to three-wheel plow provided an opportunity to improve and shorten the coupling arrangement for tandem operation and reduce the initial cost of the plow.

The single-wheel is mounted as far back as possible without being overly extended. The second plow hook-up is located behind the wheel but allows sufficient clearance on turns. As in the former design, vertical depth for operating and roading is provided by the sliding vertical shaft. An arm controls the wheel angle, and with enough bearing tolerance to absorb some shock.

Additions and deletions were necessary in revising the materials list. All bolts are now listed according to the parts with which they are used, instead of being listed as a block quantity in groups.

The original assembly drawing has been replaced by a new drawing with a RM2-25 number.

Additional improvements include:

1. Rock guard design is now available as an option.

2. End caps on the arm pin bearing replace the snap ring arrangement.

3. Patterns which have served more than a normal quantity of production have been changed from wood to metal.

4. The furrow steering wheel was improved.

5. Disc concavity was altered to improve cutting and tearing action.

One plow to be used in Region 3 has been built to these latest specifications. Detail drawings of the revisions should be used as instructions for revision of the older plows. The swinging tail beam with the couple casting and the 3½" pipe are completely removed. The new fabrication can then be installed by bolting the main beam and the front angle beam to the new fabrication and welding the box section into the side frame head casting as was formerly done with the 3½" pipe.

Rangeland Drill - Project 035.

A prototype of a new seed tube and arm was designed and fabricated. Tests were made by the Bureau of Land Management in Oregon and the U. S. Forest Service on the San Bernardino Forest. A slight modification is necessary to place seed in the furrow.

Drawings were revised to include provision for variable disc weights up to 75 lbs. and 2" x 30" pipe drags for seed covering purposes. Both are classed as optional items.

A general revision of drawings and specifications was accomplished (with difficulty) incorporating some details suggested by the 1962 contractor of the drills and others.

A parts list section was prepared for the Maintenance Manual conforming to industry procedure which should simplify parts identification by users.

The item pertaining to preparation of drawings and instructions for hinging the tongue assembly of old drills was purposely deferred pending further committee discussion. Several problems exist which were not anticipated.

Further work was done to update the drawings to take advantage of getting a better unit for the large quantity to be built during the year 1964.

1. Better location of the tool box.
2. Punch-out recesses to break down folding drawbar more readily.
3. More complete detail views for less understood parts, such as R.H. drive clutch pattern.
4. Revision of material list to better locate bolts.
5. A new hinge piece for the seed tube to prevent kinking of tube at metal top.
6. Strengthening of disc flange by providing more material thickness before machining.
7. Opening of tolerance on disc shaft to bearing fit.
8. Addition of grass seed box supports to prevent metal fracture.
9. Change to Bulldog hitch.
10. Checking of patterns for repair needs.

There was discussion by the group concerning irregularities with the drill project. A good deal of the project effort was devoted to a new seed tube and arm and the subcommittee was unaware of the situation until the prototype was ready for testing. It was brought out during this discussion that the subcommittees are established to act on suggestions for improvement of machines. It was recognized that modifications and changes will be desirable and we should be trying to improve equipment but we should do this through the committee.

It was also recognized that fabricators will be coming up with suggestions from time to time for changes in the specifications and that some of these changes could well have been tried through the committee's efforts in the past. It was generally agreed that suggestions for a change in equipment should be channeled through concerned subcommittees for screening and determination of the need for drawing revision.

Report from Exploratory Committee - Report Progress on Historical Review Project in Addition to New Proposals.

By Curt McVee, Subcommittee Chairman.

Responsibilities

The committee outlined its responsibilities and placed them in three groups:

1. Evaluate the effectiveness of previous land treatment, considering the work done by various implements or practices previously reported to the Range Seeding Equipment Committee. Practices accomplished by machines should be evaluated periodically since it is not sufficient to develop machines without considering the long term effects of the treatment accomplished by such a machine. We cannot divorce evaluation of the practice from an evaluation of the implement.

2. Collect information which can be used to recommend at any given time, by regions or site, the best treatment or practice available at that particular time.

3. Research new fields, explore the need for specialized equipment, the improvement of existing equipment not assigned to RSEC subcommittees, and development of new equipment by both private individuals and Government agencies.

Review of the Past Year's Activities

The historical review is under way. Accomplishments include establishing a format for evaluating each piece of equipment which has been considered by the Range Seeding Equipment Committee in the past. Forty-five implement reviews have been completed in draft form. It is estimated that the review will include a total of 200 individual implement write-ups.

In order to expedite this project, a master list will be prepared of all equipment ever considered by the Range Seeding Equipment Committee, and the job of preparing write-ups will be delegated to the various committee members. Our goals are now to have this material in draft form by July 1, reviewed by September 1, and available for distribution in printed form next year at this time.

Recommendations

1. A Tree Eater or Brush Hog should formally be assigned to the Brush Cutter and Chipper Subcommittee for the necessary follow-up.

2. There seems to be a considerable amount of overlap between some committees. It is felt that the Aerial Application, Ground Spraying and Chemical Plant Control Subcommittees should be consolidated. This group should be charged with pursuing and reporting chemical developments in the herbicide field.

There is a continuing need to appraise committee assignments and organization to keep up with development emphasis, and we may need a follow-up committee to evaluate work accomplished by equipment reported to this group.

3. Recommend the establishment of a Root-Cutting Equipment Subcommittee made up of individuals who are now working with and interested in this development.

4. It is recommended that the Root Plow Subcommittee be discontinued after preparing an evaluation and summary of previous actions and considerations.

5. Problems now facing us include:

   a. Stabilization of road banks, cuts and fills, etc. We should deal with the type of equipment suited for the job.

   b. Stabilization of spoil bank areas which were caused from strip mining operations. These areas can be reclaimed to produce livestock and wildlife forage as well as watershed protection.

      The same type of equipment would be suitable for most revegetation on disturbed areas. The group should give consideration to establishing a subcommittee on this problem.

Report on Technical Services.

By Eugene E. Silva, Subcommittee Chairman.

The Arcadia Development Center received $6480 this fiscal year for technical services. These funds were used as follows:

Technical Services	
Design	38%
Contracts & specifications	5%
Editing (Includes write-ups for Range Handbook)	6%
Typing	13%
Illustrating & Photo	37%
Supervision	1%
	100%

During the general discussion, Gene Silva was asked about technical services out on the projects. He told the group that they were not able to get the technician out on the ground this past year. However, it is intended that he will be available this coming year. Units wishing the technician to visit their projects should send their requests to Silva at Arcadia.

1964 Project Assignments

Subcommittee Chairmen presented their proposed projects for 1964 to the membership for group consideration. The proposals, including priorities and financing, were discussed and accepted or modified by the group. All work sheets are attached to the original of this report and each Subcommittee Chairman is being sent a copy of the 1964 work plan for his Committee.

The following assignments were made to Subcommittees:

Plastic Pipe Laying Machinery, TEB No. 1221
Group agreed that a complete pipe laying and covering machine was not needed at this time. There is need for development of a reel and shoe that can be mounted on individual agency equipment.

Project approved as proposed by Subcommittee. Work sheet attached will be the work plan for C.Y. 1964.

Arcadia to develop the reel and shoe.

Fence Building Equipment, TEB No. 1221
Project approved as proposed by Subcommittee. Work sheet attached will be the work plan for C.Y. 1964.

Arcadia will be called upon to assist in development of hitches and hydraulic systems.

Root Plowing
Project approved as proposed by Subcommittee. Work sheet attached will be the work plan for C.Y. 1964.

Seeding Equipment Handbook Revision and Preparation of Equipment Service Manuals
Project approved as proposed by Subcommittee. Work sheet attached will be the work plan for C.Y. 1964.

The preparation of a Rangeland Drill Manual has been assigned to Arcadia. $7000 is being allotted to Arcadia for specifications, drawings, and instructions.

Revision of the Brushland Plow Manual has been assigned to Arcadia with $1300 allotted for the job.

The details of completing assignments for all work to be done by this Committee will be made by letter from Subcommittee Chairman Hall. Agency representatives, Arcadia and perhaps other Subcommittees will need to assist and will be called upon.

See also Rangeland Drill assignment.

Browse Seed Collector, TEB No. 1010
Project approved as proposed by Subcommittee. Work sheet attached will be the work plan for C.Y. 1964.

Arcadia to make appropriate modifications and return harvester to Region 5 for testing.

Browse Seeder, TEB No. 502
Project approved as proposed by Subcommittee. Work sheet attached will be the work plan for C.Y. 1964.

$300 allotted to Arcadia specifically for Engineering service in the field.

Brush Cutters (Front End and Towed), TEB No. 501
Project approved as proposed by Subcommittee. Work sheet attached will be the work plan for C.Y. 1964.

Arcadia to develop signaling device and method of protecting hydraulic hoses and to check field operation for additional modification needs.

Brush Cutter-Chipper, TEB No. 1222
Project approved as proposed by Subcommittee. Work sheet attached will be the work plan for C.Y. 1964.

Arcadia, with Subcommittee and Agency assistance, to demonstrate and evaluate the "Tree Eater". This will be a multi-functional project.

Aerial Application
Subcommittee made final report to the entire Committee. Subcommittee to be discontinued. All work now being done in the chemical control field is in the Ground Spraying Equipment and Chemical Plant Control Subcommittees.

Ground Spraying Equipment, TEB No. 704
Project approved as proposed by Subcommittee. Work sheet attached will be the work plan for C.Y. 1964.

Arcadia, with assistance from the Subcommittee, to field trial, modify and retest, and prepare specifications and drawings. Modifications to include improvement of boom retraction feature and provide for 18-inch height adjustment of boom. Also design, install and test a boom mounted on a Rollagon unit.

Chemical Plant Control
This Subcommittee obtains and distributes information on chemical control of range weeds.

Project approved as prepared by Subcommittee. Work sheet attached will be the work plan for C.Y. 1964.

Interseeder, TEB No. 1566
Project approved as proposed by Subcommittee. Work sheet attached will be the work plan for C.Y. 1964.

Tractor Mounted Drill, TEB No. 1567
Project approved as proposed by Subcommittee. Work sheet attached will be the work plan for C.Y. 1964.

Rangeland Drill, TEB No. 035
Project approved as proposed by Subcommittee. Work sheet attached will be the work plan for C.Y. 1964.

Arcadia, with assistance from the Subcommittee, to performance test newly designed drill seed arm and tube, then incorporate into drawings and specs as optional item and complete revision of Rangeland Drill Manual.

Exploratory and Historical Review
Subcommittee will continue to search for areas where new work should be done. The entire Seeding Committee membership is responsible to furnish proposals for new projects to this Subcommittee.

The remainder of the C.Y. 1964 work plan for this Subcommittee is contained in the Historical Review work sheet attached, which has been approved by the entire Committee.

New Project Proposals

Disturbed Area Rehabilitation
This new project was accepted by the Committee. A Subcommittee has been appointed. The initial work will be exploratory in nature. The attached work sheet has been approved by the Committee and will be the work plan for C.Y. 1964.

Treatment Evaluation
See Treatment Evaluation work sheet attached.

The Committee accepted this proposal in principle and designated the Root Plow Subcommittee to evaluate root cutting practices and equipment in relation to long-term results. The Root Plow Equipment Subcommittee proposed a project as shown on the attached work sheet which was approved by the Committee as the work plan for C.Y. 1964.

COMMITTEE ACTION PROPOSALS

TEB #	PROJECT	FUNDS PROPOSED OTHER	ARCADIA
1223	Plastic Pipe Laying Machinery		$ 3,000
1221	Fence Building Equipment	$ 500 R-4 500 R-6	500
328	Brushland Plow		1,300
1010	Browse Seed Collector	1,000 R-5	3,300
502	Browse Planter	200 R-4	300
501	Brush Cutter (Front End & Towed)		2,000
1222	Brush Cutter & Chipper		9,000
704	Ground Spraying Equipment		3,500
	Chemical Plant Control Handbook revision typing	300 to ARS Berkeley	
1566	Interseeder	300 R-1	
1567	Tractor-Mounted Drill	500 R-3	
035	Rangeland Drill		7,000
1421	Technical Services (Engineer at Arcadia)		7,000
	TOTAL		$36,900

The above proposals have been submitted to Technical Equipment Board. TEB No. 1222 is a multiple-use project. Therefore, the Range Reseeding Equipment budget for F.Y. 1964 will be $27,900 - $12,000 BLM; $1000 BIA; $14,900 FS.

SUBCOMMITTEE ASSIGNMENTS FOR FY 1965

Seeding Equipment Handbook Revision and Preparation of Equipment Service Manuals Subcommittee

A. C. Hull, Chairman	ARS	Logan, Utah
Paul Howard	BIA	Washington, D. C.
Curtis V. McVee	BLM	Washington, D. C.
Don Atkins	SCS	Denver, Colorado
E. E. Silva	FS	Arcadia, California
Henry Mullins	FS	Albuquerque, N. M.
Fred Pratt	SCS	Washington, D. C.

Plastic Pipe-Laying Machinery Subcommittee

Warren G. Miller, Chairman	BLM	Salt Lake City, Utah
Joe V. Chiarella	BIA	Phoenix, Arizona
George N. Engler	FS	Missoula, Montana
Graham Rice	BIA	Portland, Oregon

Fence Building Equipment Subcommittee

Orval Winkler, Chairman	FS	Ogden, Utah
Maurice W. March	BLM	Boise, Idaho
Charles Waldron	FS	Portland, Oregon

Root Plowing Evaluation Subcommittee

Joseph V. Chiarella, Chairman	BIA	Phoenix, Arizona
Carl Fonte	SCS	Colorado Springs, Colo.
W. F. Currier	FS	Albuquerque, New Mexico
Morris Tragstad	BLM	Santa Fe, New Mexico
Fred Lavin	ARS	Tempe, Arizona
Hurlon Ray	SCS	Albuquerque, New Mexico
Bob J. Ragsdale	E.S.	Texas A&M, College Sta., Tex.
C. W. Luscher	BLM	Washington, D. C.

Browse Seed Collection Equipment Subcommittee

Lawrence Riordan, Chairman	Colorado F&G	Denver, Colorado
William Dasmann	FS	San Francisco, California
Charles Howard	FS	Arcadia, California
Wally McGregor	California F&G	Sacramento, California
Perry Plummer	FS	Ephraim, Utah
Richard L. Hubbard	FS (PSW)	Berkeley, California
Walter Hanson	FS	Washington, D. C.
H. Wayne Springfield	FS	Albuquerque, New Mexico
Ed. Smith	BLM	Sacramento, California

Browse Seeder Committee

Perry Plummer, Chairman	FS	Ephraim, Utah
Richard Hubbard	FS	Berkeley, California
A. B. Evanko	FS	San Francisco, California
Hugh Harper	Idaho F&G	Boise, Idaho
Walter McGregor	California F&G	Sacramento, California
Lawrence Riordan	Colorado F&G	Denver, Colorado
Norman Hancock	Utah F&G	Salt Lake City, Utah
Ed. Smith	BLM	Sacramento, California
Walter Hanson	FS	Washington, D. C.
Karl G. Parker	E.S.	Logan, Utah

Brush Cutting and Brush Beating Equipment Subcommittee

George T. Nordstrom, Chairman	BIA	Sacramento, California
A. B. Evanko	FS	San Francisco, California
Carl Rice	BLM	Sacramento, California

Brush Cutter & Chipper Subcommittee

A. B. Evanko, Chairman	FS	San Francisco, California
W. F. Currier	FS	Albuquerque, New Mexico
Carl Rice	BLM	Sacramento, California
George Nordstrom	BIA	Sacramento, California

Ground Spraying Equipment Subcommittee

A. B. Evanko, Chairman	FS	San Francisco, California
George T. Nordstrom	BIA	Sacramento, California
Charles Waldron	FS	Portland, Oregon
Carl Rice	BLM	Sacramento, California
Willis G. Vogel	FS	Springfield, Missouri

Chemical Plant Control Subcommittee

Donald R. Cornelius, Chairman	ARS	Berkeley, California
Don Hyder	ARS	Fort Collins, Colorado
Fred Tscherley	ARS	Tucson, Arizona
Robert Martin	BLM	Boise, Idaho
W. C. Robacker	ARS	Reno, Nevada
Lowell K. Halls	FS	Nocogdoches, Texas
Hurlon Ray	SCS	Albuquerque, New Mexico
Jon J. Norris	Colorado State U.	Fort Collins, Colorado
Karl G. Parker	E.S.	Logan, Utah

New Projects

Interseeder Subcommittee

Ralph Cole, Chairman	SCS	Rapid City, South Dakota
Charles Waldron	FS	Portland, Oregon
LeRoy Sweet	BLM	Denver, Colorado
Gordon Powers	BIA	Aberdeen, South Dakota
George Engler	FS	Missoula, Montana
W. F. Currier	FS	Albuquerque, New Mexico
Perry Plummer	FS	Ephraim, Utah

Tractor-Mounted Drill

W. F. Currier, Chairman	FS	Albuquerque, New Mexico
Joseph Chiarella	BIA	Phoenix, Arizona
Henry Mullins	FS	Albuquerque, New Mexico
Lawrence Riordan	Colorado Game & Fish Dept.	Denver, Colorado
A. B. Evanko	FS	San Francisco, California
Don Calhoun	BLM	Washington, D. C.

Rangeland Drill - Brushland Plow Subcommittee

A. B. Evanko, Chairman	FS	San Francisco, California
Henry Mullins	FS	Albuquerque, New Mexico
W. F. Currier	FS	Albuquerque, New Mexico
Howard DeLano	BLM	Portland, Oregon
Graham Rice	BIA	Portland, Oregon
Warren Sandau	BLM	Billings, Montana

Exploratory Subcommittee

Don Calhoun, Chairman	BLM	Washington, D. C.
A. B. Evanko	FS	San Francisco, California
Graham Rice	BIA	Portland, Oregon
A. C. Hull	ARS	Logan, Utah
B. W. Allred	SCS	Washington, D. C.
Lawrence Riordan	Colorado Game & Gish Dept.	Denver, Colorado
Hurlon Ray	SCS	Albuquerque, New Mexico

Disturbed Area Rehabilitation Subcommittee

Charles B. Waldron, Chairman	FS	Portland, Oregon
Willis G. Vogel	FS	Springfield, Missouri
S. H. Fuchs	SCS	Albuquerque, New Mexico
Orval Winkler	FS	Ogden, Utah
Vern Hamre	FS	Washington, D. C.
A. B. Evanko	FS	San Francisco, California
Clair Letson	BLM	Cheyenne, Wyoming

Register of Attendance

Agricultural Research Service

A. C. Hull, Jr.	Crops Research Laboratory, Logan, Utah
Forrest A. Sneva	Box 833, Burns, Oregon
Donald R. Cornelius	P. O. Box 245, Berkeley, California
Wesley Keller	Plant 2nd Station, Beltsville, Maryland
A. T. Black	Crops Research Laboratory, Logan, Utah

Forest Service

A. Perry Plummer	Ephraim, Utah
E. E. Silva	701 N. Santa Anita, Arcadia, California
A. B. Evanko	San Francisco, California
C. W. Howard	701 N. Santa Anita, Arcadia, California
John Forsman	Washington, D. C. 20250
Everett R. Doman	San Francisco, California
Willis G. Vogel	Berea, Kentucky
M. F. Brandborg	Denver, Colorado
R. M. DeNio	Washington, D. C. 20250
Eamor C. Nord	Riverside, California
Jerry A. Tipton	Albuquerque, New Mexico
H. A. Mullin	Albuquerque, New Mexico
H. Wayne Springfield	Albuquerque, New Mexico
Charles B. Waldron	Portland, Oregon
W. F. Currier	Albuquerque, New Mexico
Rolf B. Jorgensen	Butte, Montana
Howard Foulger	Missoula, Montana
George N. Engler	Missoula, Montana
Fred A. Cook	Delta, Colorado
Frank J. Smith	Albuquerque, New Mexico
Orval E. Winkler	Ogden, Utah
Vernon O. Hamre	Washington, D. C. 20250
John Specht	Milford, California
Avon Denham	Portland, Oregon

Soil Conservation Service

M. D. Atkins	Denver, Colorado
Lorenz F. Bredemeier	4041 No. 35th St., Milwaukee, Wisconsin 53216
Danny Freeman	Prescott, Arizona
Hurlon Ray	P. O. Box 1381, Albuquerque, New Mexico
Don S. Douglas	Milwaukee, Wisconsin
Waldo R. Frandsen	Salt Lake City, Utah
Ralph S. Cole	Rapid City, South Dakota
B. W. Allred	Washington, D. C.
Ernest C. Snook	Roswell, New Mexico
H. B. Passey	Denver, Colorado
D. M. Whitt	Washington, D. C.
Arnold Heerwagen	Denver, Colorado

Agricultural Stbilization and Conservation Service

Albert E. Pasquale	Washington, D. C.
Fred J. Pratt	Washington, D. C.

Bureau of Indian Affairs

George Nicholson	Washington, D. C.
Wilson C. Gutzman	Gallup, New Mexico
Graham Rice	Portland, Oregon
Joe A. Wagner	Washington, D. C.
Joseph V. Chiarella	Phoenix, Arizona
G. T. Nordstrom	Sacramento, California

Bureau of Land Management

Warren G. Miller	Salt Lake City, Utah
Myrvin E. Noble	Washington, D. C.
Leroy C. Sweet	Denver, Colorado
Claude A. Martin	P. O. Box 733, Albuquerque, New Mexico
James F. Kelly	Santa Fe, New Mexico
Max W. Bridge	Denver, Colorado
Warren K. Sandau	1245 N. 29th St., Billings, Montana
Curtis V. McVee	Washington, D. C.
Roger McCormack	Washington, D. C.
Robert D. Martin	Boise, Idaho
Howard R. DeLano	Portland, Oregon
Clair E. Letson	Cheyenne, Wyoming

Arizona State Land Department

Wayne Kessler	Phoenix, Arizona

Utah State University

Karl G. Parker	Extension Service, Logan, Utah

Colorado State University

Jon J. Norris	R.M., CSU, Box 1449, Fort Collins, Colo.

Texas Technological College

Ed Robertson, Jr.	Lubbock, Texas
Dan Rogers	Lubbock, Texas
Dean Chamrad	Lubbock, Texas

Texas A&M

Jim Dodd	College Station, Texas
Bob J. Ragsdale	Extension Service, College Station, Texas

University of Wyoming

Keith Severson	Laramie, Wyoming
James T. Nichols	Laramie, Wyoming

Industry Representatives

Elmer Smith	Caterpillar Tractor Co., Peoria, Illinois
Gerald W. Sharp	Sharp Bros. Seed Co., Healy, Kansas
Dwaine L. McCarty	Sharp Bros. Seed Co., Healy, Kansas
E. B. Stull	Stull Chemical Co., San Antonio, Texas
Harry C. Bryant	Fleco Corporation, Jacksonville, Florida